



RMX16 : Digital Reverberation System

User Manual Issue 1

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Intro

The AMS RMX16 was the world's first microprocessor controlled, full bandwidth digital reverberator and characterized an enormous number of seminal recordings from the 1980s onwards. Its designer's love for music and experience in the aerospace industry meant it was way ahead of its time on release.

It has remained an essential piece of kit for any self-respecting world-class studio ever since, and the units sell today for a substantial proportion of their original cost due to their great desirability.

Designed from the outset to be musical rather than simply implementing mathematical algorithms, each program was tuned and re-tuned to provide as wide a "sweet-spot" of settings as possible by means of "carpet graph" parameter tables, interactively linked control by control. It was designed by ear over an extended period of time and from first principles and this is what has made it a classic. Despite its longevity, there is little more any present-day design could better and its sound is unique and instantly recognisable.

Now available for the very first time in a plug-in, the sound once available only to premier studios is now on tap for a much wider user base.

Note: The following text is reproduced verbatim from the original user manual.

RMX16 Screenshot



The Basic Principles of Reverberation

Understanding Reverberation

The acoustic phenomenon known as reverberation accompanies nearly all of the sounds we hear, in fact we are so conditioned to hearing the accompanying reverberant field that on hearing sound totally lacking in reverberation (in anechoic chambers, well damped studios, etc.) we are immediately struck by its unnatural character.

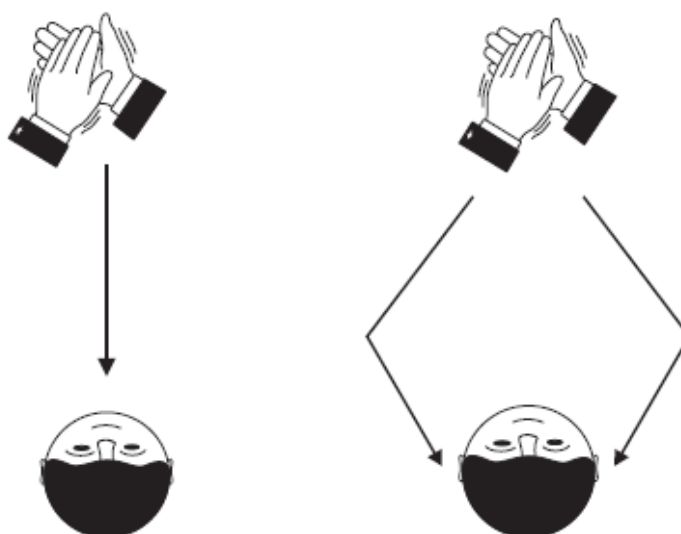
Natural reverberation not only adds a certain amount of character, or coloration, to the actual sound it is accompanying, but also 'tells' our ears from which direction the sound is coming; approximately how far away the sound is; how loud the initial sound was; what type of acoustic space we are in; how large the space is; what the boundaries are like (hard walls, curtained walls, etc.) and so on.

'Dead Room' acoustics, approaching anechoic proportions, are found more and more in modern studio designs and because of the resulting lack of natural reverberation, a good reverberation system has been found to be mandatory in modern recording studios. 'Good reverberation' is not enough however, since the studio must be capable of reproducing all types of reverberant situations from 'sitting rooms' to 'great halls'. Only modern digital systems with carefully designed programs and large memory capacity, such as the RMX 16, are capable of producing such a wide variety.

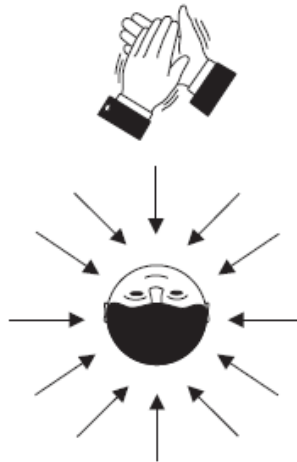
The Fundamentals of Reverberation

Let us say you are in the centre of a small hall and someone, standing a few feet away, claps their hands. Immediately the resulting sound wave will radiate in all directions at an approximate rate of one foot every millisecond. The first sound you will hear will be that which comes directly towards you from the clapped hands. Thanks to our well developed binaural hearing this 'Direct Sound' will tell us where the sound source is.

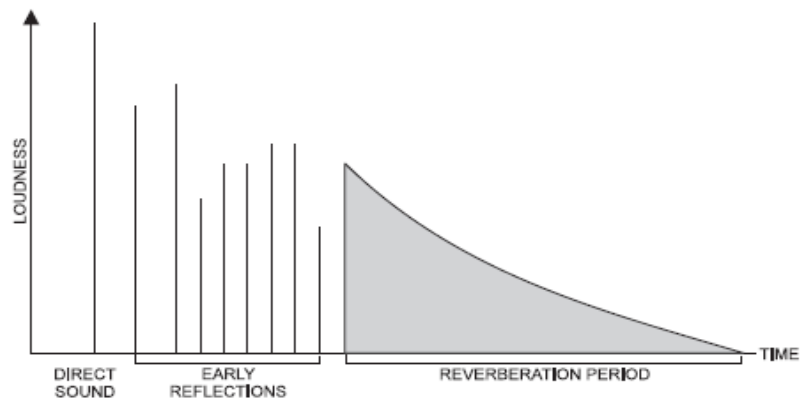
Next come the 'early reflections'; remember sound was radiated in all directions and some of this radiated energy, on striking room boundaries (walls, floors, ceilings, etc.), will again be directed towards your ears. These early reflections may be slightly different in character from the original sound since not only is some of the energy absorbed by the boundary upon which the wave strikes, but this absorption also varies depending on the frequency.



These early reflections can extend from 5ms in a small room to some 200ms in a large hall. Even at 200ms, if the sound is not impulsive, we are unable to pick out individual reflections during this period, but we are able to extract important psycho-acoustic information about the type of hall and the type of boundaries involved.



These reflections eventually build up into an extremely dense, omni-directional reflection pattern called the 'reverberant period'. At this stage so many reflections are arriving at once that a pleasing diffuse sound is heard which slowly dies away.



Stereo From a Mono Source

Another important aspect of sound in any acoustic space is its binaural nature. Sound occurs in three dimensional space and even a single hand clap is heard in stereo, even though emanating from a single source. The stereo image is created by each ear receiving a slightly different pattern of reflections, coming from different directions at different times. The 'stereo image' in artificial reverberation is an extremely important concept and should not be ignored. We never hear truly mono sounds in nature.

Operating Instructions

With digital reverberation one can simulate mathematically any real environment and also any 'old fashioned' artificial reverberant character such as 'plates', or 'springs'. Digital reverberation techniques are the first to offer such sophistication.

The RMX16 digital reverberation system employs sophisticated micro-programmed parallel processing of 16 bit data offering an 18kHz bandwidth; 90dB dynamic range and 0.03% distortion in delay mode; independent control of each program's fundamental reverberant parameters; alphanumeric program descriptions for ease of use and 'at a glance' understanding of how the RMX16 is currently programmed as all data, including the variables (pre-delay, decay time, high frequency decay profile and low frequency decay profile), are continuously displayed on the reverb front panel.

The RMX16 is designed to be simple to operate with nine factory programs simulating different reverberant environments with the ability to control all parameters.

A calculator styled keypad is provided for entry of user definable variables.

Both input and output levels are adjustable to accommodate sources and destinations sending or requiring non-standard signal levels. Overflow indication on digital processing is provided as well as the standard 'traffic signal' LEDs enabling fine adjustment of input level for optimum signal to noise performance.

When changing basic reverberation programs, the output is muted so that 'memory flush-out' is not output to the audio chain. A useful feature incorporated into the RMX 16 reverberation system is the use of 'Nudge Buttons'. These buttons increment or decrement data for all selectable functions.

Operation

This section is intended to familiarise the user with the front panel controls of the RMX16 reverberation system. Frequent reference to the front panel drawing at the front of the manual is therefore recommended when following this section.

Input / Output Level And Level Monitoring Section

When the unit is switched on, the front panel LEDs will illuminate. Between the Input level and Output level control knobs there are four LEDs (green, yellow, red and red). The first three (i.e. green, yellow and red) are basic 'traffic signal' level LEDs. The red LED is illuminated 6 dB, the yellow LED 12 dB and the green LED 18dB before clipping. In normal operation, with a signal present, the input level should be adjusted so that the red LED is illuminated only when the highest programme peaks occur. The remaining red LED indicates processing overflow. Should this occur, due to exceptional program material, 'backing off' the input level slightly will prevent internal clipping of the signal.

Once the input signal has been 'level matched' using the traffic signal LEDs, the output (stereo) can be adjusted to give a good match on the output.

The output from the RMX16 is true stereo and while these outputs may be used singly, a more solid spatial sound will be obtained by using the stereo pair.

The Pot Control Section

Depressing the decay time, pre-delay or Dry/Wet keys, hands control of that parameter over to the rotary control knob above the actual pot key. This facility can only be used once that parameter key function has been selected.

Program Selection

To select one of the reverberation programs first push the 'program' key, the LED on this key will now illuminate. Actual program selection can be accomplished in two distinct ways:

Keypad Entry

To select a reverberation program using the keypad, enter a single digit number between 1 and 9 followed immediately by the 'enter' key (#); the required program will then be loaded. Once a program number has been selected the LED on the 'program' key will flash until the 'enter' key (#) is pressed. If the program number selected is not available (e.g. greater than 9), then the error message (E) will be displayed above the 'program' key. No change in program will result and therefore the program LED will still flash. Re-pressing of the 'program' key will clear the error condition from the display.

Using The Nudge Keys

The 'nudge' keys are very useful for jumping from one program to another. Once 'program' has been selected, a nudge up will increase the program number while a nudge down will decrease the program number. It should be noted that when changing between basic programs, the output is muted for a short period so that 'memory flush-out' is not output to the audio chain.

Note: Any custom settings made to a program are lost when changing between programs.

Pre-Delay Entry

Pre-delay, delays the onset of reverberation giving the impression of distance from the sound source. To introduce a pre-delay before reverberation occurs, first push the 'pre-delay' Key.

The LED on this key will now illuminate. Again, actual pre-delay setting can be accomplished in three distinct ways:

Keypad Entry

Using the keypad, enter the amount of pre-delay required followed by the the enter key (#). The amount (ms) of pre-delay will be displayed above the 'pre-delay' key and as information is entered from the keypad the LED on the 'pre-delay' key will flash. If the requested pre-delay time is within certain limits, the output will be delayed with respect to the input by this amount and the LED will stop flashing. If the requested pre-delay time is greater than that which is available using the program selected, the error message (E) will be displayed above the 'pre-delay' key. No change in the program will result so the 'pre-delay' LED will continue flashing. To clear this error the 'pre-delay' key should be pressed again.

Using The Nudge Keys

If the Nudge Keys are used, the pre-delay amount will be increased or decreased; the step size being program dependent. It is important to remember that the maximum available pre-delay time depends on the basic reverberation program in use. The maximum pre-delay time for each reverberation program is given in the program notes at the back of this manual (see APPENDIX B).

Pot Control Entry

You can also vary the pre-delay using the pot control. Once the pre-delay function has been selected, control of the pre-delay is immediately available to the rotary pot directly above the pot key.

Decay Time Entry

To vary the decay time first push the 'decay time' key. The LED on that key will now illuminate. There are three ways of adjusting decay time:

Keypad Entry

Decay time may be selected using the keypad. Both the minimum and the maximum decay times are dependent upon the program selected. Fractions of a second are entered by using the '*' key as a decimal point. Hence 2.8 Seconds would be entered by first pressing the 'decay time' key followed by the '2' key, the '*' key, the '8' key and finally the enter key (#).

Using The Nudge Keys

Once the 'decay time' key has been pressed, an increase or decrease in the decay time can be accomplished by the use of the nudge keys. Depressing the nudge up key will result in the illumination of the nudge up LED and an increase in the decay time. Depressing the nudge down key will result in illumination of the nudge down LED and a corresponding decrease in the decay time. The decay time will increase or decrease in 0.1 second steps.

Pot Control Entry

You can also vary the decay time using the pot control. Once the decay time function has been selected, control of the decay time is immediately available to the rotary pot directly above the pot key.

Decay Filter Controls

The availability and use of these controls is dependent upon the basic reverberation program in use (See Appendix B).

For example PROGRAM 1 allows use of both the high and low filter controls while PROGRAM 3 allows for use of the high filter control only.

A positive filter setting will produce an increase in reverberation time in the selected frequency band while a negative value will give a decrease. A low frequency filter setting of, say +9, will give a large increase in reverberation time in the low frequency band.

To select negative values the '*' key must be pressed prior to entering the numeral. If the '*' key is not pressed a positive value is assumed.

The decay filter controls may be changed by using the nudge buttons.

Dry/Wet

These two buttons control the balance between the reverb processor and the source signal when Wet Solo mode is inactive.

The Dry/Wet mix is indicated in the Numerical Display as a percentage. A value of 50 produces an equal blend of the wet and dry signals. Values greater than 50 emphasize the wet signal, and values less than 50 emphasize the dry signal.

Keypad Entry

Dry/Wet mix may be selected using the keypad. Hence 50.5% would be entered by first pressing the 'Dry/Wet' key followed by the '5' key, the '0' key, the '*' key then the '5' key and finally the enter key (#).

Using The Nudge Keys

Clicking the nudge down button once will decrement the value by one percent; clicking nudge up once will increment the value by one percent. To increase the fine resolution when adjusting these controls, hold SHIFT (on the computer keyboard) when clicking the controls. Shift+click will decrement (nudge down) and increment (nudge up) by a value of 0.1 percent instead of one percent.

Pot Control Entry

You can also vary the Dry/Wet mix using the pot control. Once the Dry/Wet function has been selected, control of the Dry/Wet is immediately available to the rotary pot directly above the pot key.

The Dry/Wet controls are typically used when RMX16 is inserted on individual channels. When RMX16 is used on a group/bus in a typical reverb send/return configuration, set to 100% WET or activate Wet Solo mode.

Using the RMX 16

Once the RMX16 has been correctly 'level matched' decide which basic program is needed for the effect you require. Reading through the program list in APPENDIX B will help if you are already familiar with basic reverberation sounds. If you are not it is advisable to listen to all of the basic pre-set programs using the material you wish to record as the source.

You will then be able to select the basic program nearest to the effect you require. Do not use source material with a fundamentally different frequency character than the material you will eventually record, this will give you a false impression of the final sound. Almost all reverberation types, especially when using large amounts of frequency contouring, are dependent upon the frequency character of the source material.

Press the 'program' key and nudge up or down through the programs to the one required. The program number appears on the left of the display, the program

name on the right. Whether nudging up or down, the output will be muted for a short time. Mute time is not compounded i.e. is the same regardless of how many programs are nudged through and which program you are nudging to or from. There are nine factory pre-set programs; choose the one you wish to use and refer to the program notes at the back of this manual (APPENDIX B). These notes give the maximum pre-delay, the maximum decay time and the decay filter ranges available when using each particular program.

Pre-Delay

Pre-delay offsets the output of the RMX16 relative to the input. When mixing the original with the output of the reverberation system a variety of material can be enhanced by adding pre-delay; knowing when to use pre-delay and how much to use comes with experience.

Decay Time

Increasing decay time effectively increases the length of the final phase of reverberation i.e. the reverberant period. By using the 'pot' control the decay time may be varied at any time during a mix.

Decay Filtering

The effectiveness of these controls depends to a large extent on the frequency character of the source material. The high frequency filter will have no effect at all on low range instruments like the bass guitar whereas cymbals, violins, etc., will be affected to a large degree; there is no substitute for experimentation.

Keyboard text Entry

Text entry can be used to change any of the parameters displayed on the numeric displays. Click on the display parameter you want to modify and use the keyboard to type a new value followed the enter key.

Specifications

Electrical

Distortion:	Less than 0.03% at 1KHz, full output.
Dynamic Range:	90dB.
Frequency Response:	20Hz to 18KHz : - 3dB, + 0dB.
S/N Ratio:	Dependent upon reverberation program selected but typically 86dB.

Nudge:

Program:	Will nudge through programs allowing quick selection of program required.
Pre-delay:	Nudges from 0 to maximum in steps of 10 milliseconds.
Decay time:	Nudges from 0 to maximum in 0.1 second steps.
Decay filtering:	Nudges up and down in single digit steps.

Keypad Control:

Program Entry:	Keypad entry 1 to 9.
Pre-delay Entry:	Keypad entry 0 to maximum (dependent upon program selected), least significant digit = 1mS
Decay Time Entry:	Keypad entry least significant digit = 0.1 Second '*' acts as decimal point.
Filter settings:	Keypad entry of signed single digit numeric. '*' acts as minus sign. Positive value implied if digit not preceded by '*'.
Display Comprises:	11 x 7 Segment digital characters with 8 x 17 Segment star burst alphanumeric characters.

Appendix B

Program Index

Program	Title	Number
1	Ambience	
2	Room	A1
3	Hall	C1
4	Plate	A1
5	Hall	B3
6	Chorus	
7	Echo	
8	Nonlin	2
9	Reverse	1

Program 1 AMBIENCE

This program is a very useful and flexible general purpose program with an effect somewhere between a hall and a plate. It is useful for increasing reverberation time on material with existing reverberation, or producing unobtrusive reverberation on dry material.

It differs from a hall in that dimensional elements are deliberately minimised, and differs from a plate in its lower coloration.

Pre-delay to 200ms is selectable and low and high frequency profiles can be modified.

Two special features of the program are that a setting of 9.9 on the decay controls gives an almost infinite decay time, and if the filters are set to their zero positions, the decay continues with all original harmonic information without air absorption simulation. This allows voices to be added into the sound one at a time to create a "choir" effect. This can also be described as a 'freeze' setting and can be initiated by selecting 'pot' on the decay control and rapidly turning from minimum (0.0) to maximum (9.9) settings as the sound you wish to 'freeze' occurs.

CAUTION

Since internal multiplying parameters are unity in this mode, after a long period of time in this condition - several minutes, or tens of minutes - the output dynamic range may limit due to very small DC offset voltages building up. The overflow LED will illuminate to show this. The condition is simply cleared by returning the decay setting to zero momentarily. In any case the effect is available for ample time for all useful purposes without problem.

Program 2 ROOM A1

This program is designed to replicate a 'live' room with all the attendant colourations.

Decay time should be kept short for most realism (to 1 or 2 seconds), and a high degree of high frequency damping sounds best (say -7,-8). Low frequency equalisation is not provided for this program.

Colouration is made deliberately high to simulate standing waves in real rooms. All types of material are suitable for this program. Pre-delay to 300 milliseconds is selectable.

Program 3 HALL C1

This hall program has strong initial reflections thus defining the size of the hall distinctly, giving high presence, making it very useful for vocals.

For example: for 'topping up' material already recorded in halls, a more neutral program such as Ambience is recommended, to avoid two possibly conflicting sets of early information.

Control of both high and low frequency profiles is provided as in program 1 above.

Program 4 PLATE A1

This is a program with high diffusion, similar to that produced by plate reverberators.

Percussive sounds are rapidly smoothed with this program. Colouration is medium and decay even, as with standard plate reverberators.

Decay times of up to 5 seconds are useful for normal use, and above for special effects.

Indicated decay times are accurate to about 5 seconds, but it should be noted that perceived delay time will depend greatly on the frequency spectrum of the input program material referred to the filter settings. Pre-delay of up to 300ms is selectable.

Control of high and low frequency decay times is available.

Program 5 HALL B3

This program is similar to Hall C1, but has lower energy initial reflections.

Pre-delay of up to 200ms is available.

Control of both high and low frequency equalisation is available.

Program 6 CHORUS

This is a five voice program which is very useful for 'filling out' voices and certain instruments.

The five voices are panned across the stereo image and are separated from each other by randomised delays operating on each voice. In addition, a basic separation is also selectable to bring the voices 'closer' together or to 'spread out' the image in time and space.

The program is controlled as follows:

The PREDELAY control affects the separation of the voices, as described above. The nudge control increment in steps of 1ms instead of the normal 10ms because of the short delay nature of this program. The maximum value selectable is 50ms which, over the five voices, gives a total spread of 250ms.

At settings below about 6ms useful phasing/flanging/tunneling effects are available. These effects are especially evident if the outputs are summed to mono.

The 'depth' of the randomising and pitch changing effect is controlled by the DECAY control.

High frequency filtering of all voices is available.

NOTE:

- (1) Phase cancellation and addition are very strong in this program by design, which can mean that slight adjustment of the input level control may be necessary dependent on program material to avoid overflow conditions.
- (2) This program is designed to be used mainly with voices. Program material with pure notes or large amounts of high frequency energy may introduce varying amounts of interference signal components due to discrete stepping of time increments as in other reverberation systems. This may be reduced by use of the high frequency filtering control.

In most cases however, very good effects can be obtained from this program as long as care is taken in choosing the relevant source material.

Program 7 ECHO

This program provides two high quality, completely independent and programmable outputs from a single input. Control of decay is via PREDELAY, of feedback level (regeneration) via the DECAY control and high and low filtering can be selected in the decay path in the normal way.

To select which output to program, the 'A' or 'B' keys should be depressed as appropriate. The program title will reflect this selection, displaying ECHO A or ECHO B accordingly.

To allow the greatest flexibility in generating effects with this program, the maximum delays selectable on each output have been set differently - either 650ms / 150ms or 1.2s / 400ms.

This program can be used to great effect for double / triple tracking, longer delays simulate tape echo, and very long delays with high degree of feedback allow a musician to effectively 'play along' with himself by laying a new bar on top of previous slowly decaying bars to build up a very full sound. Since the regeneration is accomplished in the digital domain, a very clean effect is generated. Both high and low frequency profiles can be modified.

Program 8 NONLIN 2

This is an unusual program for special effects or loudness enhancement, in which the sound decays only very slightly for a period of time (set by the decay control), and then dies away very rapidly. It is especially useful on drums, and at small settings of decay produces a very good room effect. The decay values are not calibrated in this mode, but values may be used for reference. Unlike NONLIN 1, the output is in stereo, and filtering at high frequencies is available.

Program 9 REVERSE 1

This is another special effects program with dispersed reflections on the left output and more discrete reflections on the Right output.

Dependent on the setting of the decay control, the reverberating sound builds up for a period of time then suddenly stops - the reverse of natural reverberation. Again decay settings are not calibrated but may be used for reference.

A pre-delay is selectable before the start of the reverb build up.

Appendix C

High and Low Frequency Decay Characteristics

High and low frequency profiles may, for many programs, be modified as specified below. These figures apply to the final, reverberant phase of the decay or each program, but early reflections are also affected in certain programs, so the figures should be used as a guide only. The final setting should be selected by ear.

Nominal High Frequency Decay Control Characteristics

Setting	Half decay time frequency
0	18 kHz (flat)
-1	15 kHz
-2	10 kHz
-3	8 kHz
-4	6.5 kHz
-5	5 kHz
-6	3.5 kHz
-7	2 kHz
-8	1.5 kHz
-9	1 kHz

Low Frequency Decay Control Characteristics

The low frequency filter control affects the decay time of the reverberant phase of the programs at a frequency of 350Hz, varying nominally from a quarter of the indicated time at a setting of -9, to four times at +9. Program material content varies the subjective effect of this control considerably; again it is best set by ear.